SOIL AND HYDROLOGY SPECIALIST REPORT

Yuba Enhancement Trail Project

Tahoe National Forest
Yuba River Ranger District
September 25, 2018

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Table of Contents

1 Introduction

The purpose of this report is to analyze the soil and hydrologic impacts of the proposed Yuba Enhancement Trail Project.

The report describes the current soil and hydrology conditions for the project activity areas, analyzes the potential effects that the proposed project might have on the soil and hydrology resources, and specifies mitigation in the form of management requirements that would minimize adverse effects on these resources.

The report includes:

- the regulatory framework and applicable standards and guidelines used to evaluate soil and hydrology condition and the potential impacts of proposed treatments;
- a description of the indicator, metrics and methods used to assess the effects of the project on soil and hydrology resources;
- a description of the affected environment, including a listing of the soil in the project activity area and streams.
- an assessment of the direct, indirect, and cumulative effects of the proposed action on the soil and hydrology resources.

2 REGULATORY FRAMEWORK

Management actions must occur in conformance with applicable law, regulation, policy, guidance, and management direction. This regulatory framework determines the overall objectives and standards and guidelines applied to project activities and managing the soil resource.
Specific measures, indicators, and thresholds are established through this regulatory framework and used in assessing soil condition, and used to evaluate the effects of the proposed project on the soil resource- what gets looked at, why, and interpretation of what it means to soil quality and site productivity.

2.1 Law, Regulation, and Policy

National Forest Management Act 1976

The National Forest Management Act of 1976 (NFMA) recognized the fundamental need to protect, and where appropriate improve, the quality of soil, water, and air resources. With respect to water and soils, NFMA requires that the Forest Service manage lands so as not to impair their water quality and long-term soil productivity. Further, activities must be monitored to ensure that productivity is protected. This law led to subsequent regulation and policy to execute the law at various levels of management.

Clean Water Act of 1948 (as amended in 1972 and 1987) establishes as federal policy the control of point and non-point pollution and assigns the States the primary responsibility for control of water pollution. Compliance with the Clean Water Act by national forests in California is achieved under state law.

This project complies with the Clean Water Act through use of "Best Management Practices" designed to minimize or prevent the discharge of both point and non-point source pollutants from Forest roads, developments and activities. Under the Clean Water Act regulations, the Forest Service is required to obtain permits from the California Regional Water Quality Control Board (RWQCB). At this time, the Forest Service is working with the RWQCB to secure the appropriate permit(s) for this project.

The California Water Code consists of a comprehensive body of law that incorporates all state laws related to water, including water rights, water developments, and water quality. The laws related to water quality (sections 13000 to 13485) apply to waters on the national forests and are directed at protecting the beneficial uses of water. Of particular relevance is section 13369, which deals with nonpoint-source pollution and BMPs.

The Porter-Cologne Water-Quality Act, as amended in 2006, is included in the California Water Code. This act provides for the protection of water quality by the State Water Resources Control Board and the Regional Water Quality Control Boards, which are authorized by the U.S. Environmental Protection Agency to enforce the Clean Water Act in California.

Regional Water Quality Control Boards are the primary regulatory agencies for water quality in California. Each Regional Board has a Basin Plan that includes identified beneficial uses and water quality objectives (standards) for water bodies within each region. Basin Plans may include prohibitions of pollutant discharges, and are incorporated into the California Water Code. As such, Basin Plans are enforceable laws.

Non-point source pollution on national forests is managed through the Regional Water Quality Management Plan (USDA Forest Service, Pacific Southwest Region, 2011), which relies on implementation of prescribed best management practices. The Water Quality Management Plan includes BMPs for timber harvesting, road building and maintenance, and protection of Riparian Conservation Areas.

Working cooperatively with the California State Water Quality Control Board, the Forest Service developed pollution control measures, referred to as Best Management Practices (BMPs) that are applicable to National Forest System lands. The BMPs were evaluated by State Water Quality Control personnel as they were applied on site during management activities. After assessment of the monitoring data and completion of public workshops and hearings, the Forest Service's BMPs were certified by the State and approved by the Environmental Protection Agency (EPA) as the most effective means to control non-point source pollution.

The land treatment measures incorporated into Forest Service BMPs evolved through research and development measures, and have been monitored and modified over several decades with the expressed purpose of improving the measures and making them more effective. On site evaluations of the control measures by State regulatory agencies found the practices were effective in protecting beneficial uses and were certifiable for Forest Service application as their means to protect water quality. The Clean Water Act provided the initial test of effectiveness of the Forest Service non-point pollution control measures by requiring evaluation of the practices by regulatory agencies (State Board and EPA) and the certification and approval of the practices as the "BEST" measures for control.

BMPs are designed to accommodate site-specific conditions. They are tailor-made to account for the complexity and physical and biological variability of the natural environment. In the 1981 Management Agency Agreement between the State Water Resources Control Board and the Forest Service the State agreed that: “The practices and procedures set forth in the Forest Service document constitute sound water quality management and, as such, are the best management practices to be implemented for water quality protection and improvement on NFS lands.” Further the Water Quality Control Plan for the Central Valley Regional Water Quality Control Board states “Implementation of the BMPs, in conjunction with monitoring and performance review requirements approved by the State and Regional Boards, is the primary method of meeting the Basin Plan’s water quality objectives for the activities to which the BMPs apply.”

2.1.2 Management direction, standards and guidelines

The Tahoe National Forest Land and Resource Management Plan (LRMP 1990), as amended by the Sierra Nevada Forest Plan Amendment (SNFPA 2004), provides direction for maintaining water quality and quantity; protecting streams, lakes, wetlands, and riparian conservation areas; and to prevent excessive, cumulative watershed impacts.

Riparian Area Management (Sierra Nevada Forest Plan Amendment (SNFPA, 2004).

This document requires that a site-specific project-level analysis be conducted to determine whether activities proposed within Riparian Conservation Areas (RCAs) meet the Riparian Conservation Objectives (RCOs). This analysis examines how well the Proposed Action for the Yuba Enhancement trail project meets the Riparian Conservation Objectives and/or how it would bring the Yuba Enhancement trail project area closer to meeting these objectives.

The following goals are part of the Aquatic Management Strategy (AMS) as presented in the Sierra Nevada Forest Plan Amendment (SNFPA), Final Supplemental Environmental Impact Statement, Record of Decision (USDA 2004):

1. Water Quality -- Maintain and restore water quality to meet goals of the Clean Water Act and Safe Drinking Water Act, providing water that is fishable, swimmable, and suitable for drinking after normal treatment.
2. Species Viability -- Maintain and restore habitat to support viable populations of native and desired non-native plant, invertebrate, and vertebrate riparian-dependent species. Where invasive species are adversely affecting the viability of native species, work cooperatively with appropriate State and Federal wildlife agencies to reduce impacts to native populations.
3. Plant and Animal Community Diversity -- Maintain and restore the species composition and structural diversity of plant and animal communities in riparian areas, wetlands, and meadows to provide desired habitats and ecological functions.
4. Special Habitats -- Maintain and restore the distribution and health of biotic communities in special aquatic habitats (such as springs, seeps, vernal pools, fens, bogs, and marshes) to perpetuate their unique functions and biological diversity.
5. Watershed Connectivity -- Maintain and restore spatial and temporal connectivity for aquatic and riparian species within and between watersheds to provide physically,

chemically and biologically unobstructed movement for their survival, migration and reproduction.

6. Floodplains and Water Tables -- Maintain and restore the connections of floodplains, channels, and water tables to distribute flood flows and sustain diverse habitats.
7. Watershed Condition -- Maintain and restore soils with favorable infiltration characteristics and diverse vegetative cover to absorb and filter precipitation and to sustain favorable conditions of stream flows.
8. Streamflow Patterns and Sediment Regimes -- Maintain and restore in-stream flows sufficient to sustain desired conditions of riparian, aquatic, wetland, and meadow habitats and keep sediment regimes as close as possible to those with which aquatic and riparian biota evolved.
9. Stream Banks and Shorelines -- Maintain and restore the physical structure and condition of stream banks and shorelines to minimize erosion and sustain desired habitat diversity.

A key element of the Aquatic Management Strategy is a set of land allocations, specifically riparian conservation areas and critical aquatic refuges, that delineate aquatic, riparian, and meadow habitats, which are to be managed consistent with the riparian conservation objectives (RCOs) and associated standards and guidelines. The RCO analysis is included in the project environmental analysis.

Water Quality Protection (V-35)

Use Best Management Practices (BMPs) to meet water quality objectives and maintain and improve the quality of surface water on the Forest. Methods and techniques for applying the BMPs will be identified and documented during project level environmental assessments and incorporated into the associated project plan and implementation documents.

2.2 Trail monitoring

To predict the future impacts on trail condition, the Butcher Ranch trail was monitored. This motorized trail was recently constructed using the same trail construction standards and BMPs as the proposed Yuba Enhancement trail project. Over the one mile of trail, excessive erosion and tread wear were negligible. The route crosses several low water stream crossings with short approaches that were in good condition and had very low rates of sediment entering the channel.

3 METHODOLOGY

3.1 Indicators Metrics and Methods

Activity units were evaluated to determine if desired condition for soil and hydrology indicators were met. Soil desired condition are met if tread condition is functional as determined by the Green Yellow Red OHV trail condition monitoring form (GYR form). The measure for this indicator is miles of trail in the yellow or red condition for the condition codes relating to tread condition. The GYR form is designed to rate segments of trail condition. Green trail segments have functional water control, no accelerated erosion off trail, and minimal tread wear. Yellow segments may have insufficient waterbreaks, rill erosion and/or sediment deposition occurring at waterbreak outlets, or tread incised 6 to 12 inches. Red segments have waterbreaks that no longer divert runoff from the trail, gully erosion occurring at waterbreak outlets, or tread incised greater than 12 inches.

Hydrology desired conditions are met if trail water control is sufficient to prevent hydrologic connectivity. The hydrology indicator is miles of trail hydrologically connected.

4 AFFECTED ENVIRONMENT

4.1 Existing Conditions

The purposes of field work were to: (1) validate the soil survey mapping, (2) gather information on site-specific soil and hydrologic properties, (3) assess current soil, hydrology, and riparian conditions as affected by past trail building in the HUC7 watersheds, (4) determine level of mitigation measures and (5) develop predictions on soil and hydrologic response to the proposed trail construction.

Geology
The project area is comprised of sedimentary and medisedimentary rocks. Colluvial erosion and, in the river canyons, mass wasting are the main geomorphic processes.

Soil
Soil survey information is used to describe project area soil. Soil information for the project area was obtained from two sources: the Tahoe National Forest Soil Resource Inventory (1980), and field observations of the project area (2018). Major map units associated with the Yuba Enhancement Trail Project area include Waca very rocky loams (21 percent), Smokey (17 percent), Rock outcrop (16 percent), Meiss (9 percent), and Deadwood (6 percent).

Waca and Meiss soils formed in residuum weathered from volcanic rock. Smokey and Deadwood soils formed in residuum weather from metasedimentary rock. These parent materials have weathered to loam and sandy loam textures. The Waca, Smokey, and Deadwood soils contain gravels in the surface horizon.

The Waca and Smokey soils have high amounts of rock fragments and snowmelt tends to accumulate for short periods over the impermeable substratum of the Waca soil. Meiss and Deadwood soils are shallow to hard bedrock, reach field capacity rapidly, and can produce surface runoff. Areas of rock outcrop can increase erosion on soils below.

The following proposed re-route sections are not meeting desired conditions because of high rates of accelerated erosion and tread wear. As a result, trail widening is also occurring on most of these sections as trail riders avoid the problematic sections.

The 0.8 mile proposed re-route section of the Downie River/Rattlesnake Trail is on slopes 25 to 40 percent and several approaches to ephemeral low water crossings are long and steep and contribute moderate amounts of sediment to the drainages. The friable, gravelly soils on steep slopes are easily loosened by mechanical dusting of uphill dirt bike traffic. Accelerated erosion is high because the steep slopes are in alignment with the natural flow of runoff.

The 0.15 mile proposed re-route section of the Pauley Creek trail is on slopes of 25-35%. Concentrated runoff follows the bottom few hundred feet of this section and sediment enters the ephemeral drainage just below. Tread is decompacted by the mechanical forces of mountain bikes braking and the loosened soil is more easily transported by the erosive force of runoff.

The 1.5 mile proposed re-route section of Lavezzola trail is on slopes of 25 to 40 percent. The friable, gravelly soils are easily loosened by mechanical dusting of uphill dirt bike traffic. Accelerated erosion is high because of steep slopes which are in alignment with the natural flow of runoff. Several hundred feet of the existing trail are contributing sediment to a perennial tributary to Spencer Creek.

Three different sections of Big Boulder are proposed for re-route and total 1 mile. Gully erosion is occurring on a 400 foot section of 20 percent slope where water runs onto the trail from an abandoned mine. The other sections are on steep slopes of 25 to 40 percent and accelerated rill erosion is occurring.

Upland Characteristics

Hillslopes in the project area range are mostly steep. The uplands are dominated by conifer vegetation with a mixed understory that acts to provide ground cover to aid in erosion control. The hillslopes are mostly stable with no evidence of significant surface erosion.

Channel Characteristics

Ephemeral streams in the project area are primarily steep headwater colluvial channels (Montgomery and Buffington 1997). These channels are narrow and shallow and are sometimes hard to define on the ground due to their headwater location. They experience highly sporadic fluctuations in runoff and accumulate sediment from the hillslope over long time periods (decades to centuries). They then flush such sediment downstream during infrequent high runoff events or debris flows (Montgomery and Buffington 1997). Such channels are described as transport-limited and respond to changes in sediment supply by fluctuating the amount of sediment in storage and changes in runoff by changing the frequency of sediment flushing events.

Downstream of the colluvial headwater streams are steep bedrock, cascade and step-pool channels (Montgomery and Buffington 1997). They are high gradient, high-energy, supply-limited systems; in the sense that they exhibit a high capacity to transport sediment relative to sediment supply. Therefore, these channels are able to withstand temporal increases in sediment supply and efficiently transport such supply increases through the system (Montgomery and Buffington 1997). Also, these channels are often stable enough to withstand large flood events or periods of low sediment input.

Intermittent and perennial streams in the project area have steep headwater channels that become more gradual as they approach the North Fork Yuba River. The perennial streams alternate between low gradient pool-riffle and steeper bedrock or step-pool segments. The steep sections follow the descriptions above for the tributaries. The low gradient segments are relatively lower energy than steep segments and therefore have a lower sediment transport capacity relative to supply. This results in these low gradient segments being more sensitive to changes in sediment supply or streamflow. Increased supply or decreased runoff can result in detrimental sediment deposition while decreased supply or increased runoff can cause erosion and the streambed and banks (Montgomery and Buffington 1997).

Overall, channel segments in the project area appear stable with minimal evidence of excessive erosion or deposition of sediment.

4.3 MANAGEMENT REQUIREMENTS

Environmental effects are assessed with the intent and assumption that the management requirements included in the Table 1 are effectively applied to the action alternatives. Management requirements are prescriptive measures that aim to prevent adverse effects upon the soil and hydrology resources and include measures to ensure the standards for these resources are attained. Some management requirements incorporate mitigation measures to be conducted in conjunction with operations for treating unavoidable adverse effects.

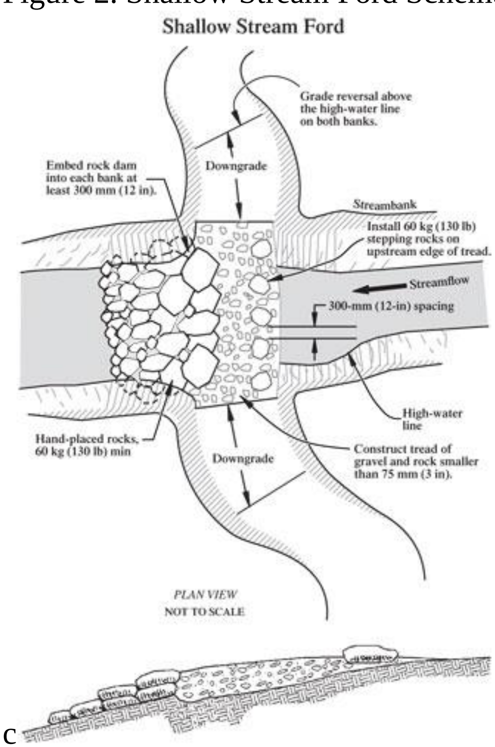
Table 1: Proposed soil and hydrology management requirements

Watershed, Soils, & Aquatic Resources – Shallow stream fords.	When constructing shallow stream fords, locate in shallower portions of the stream. The approaches should climb a short distance above the typical high water line so that water isn't channeled down the tread. Avoid locations where the stream turns, because the water will undercut approaches on the outside of a turn. The tread in the ford should be level, ideally made of rock or medium sized gravel that provides solid footing. The plan is to even out the waterflow through the ford so the gravel-sized material isn't washed away, leaving only cobble or boulders.	Trail Construction Team

Watershed, Soils, & Aquatic Resources – Trail approaches to watercourse crossings.	Design watercourse crossings to avoid diversion of flow down the trail should the crossing fail (Figure 2). Where possible, make crossing approaches short and level, or reverse the grade if possible. Install cross drainage (cut-off waterbreaks) at crossings to prevent water and sediment from being channeled directly into watercourses. Locate cut-off waterbreaks as close to the crossing as possible without being hydrologically connected to the watercourse. Armor steep crossing approaches with stable aggregate or trail-hardening materials. Where possible (for example, at bridges or arch culverts), reverse the grade of the crossing approaches so runoff drains away from the watercourse.	
Watershed, Soils, & Aquatic Resources – Trail Decommissioning	Administratively close decommissioned trail sections to continued use. Obscure the first 100 feet of the old trail at intersections with the new re-routes and place large amounts of woody debris on them to discourage any further use. Maintain at least 70 percent effective soil cover prior to winter precipitation. If soil cover cannot be recruited on site, use biodegradable geotextile netting. Where possible, scarify top 2-4’’ soil to promote water infiltration and return of vegetation.	

Watershed, Soils, & Aquatic Resources – Trail Drainage	Look for small draws to locate grade reversals. The trail should climb gently for a few feet on each side of the draw. Construct a trail grade that is less than half of the sideslope grade. For example, on a hill with 6-percent sideslope, trail grade should be no more than 3 percent.	
Watershed, Soils, & Aquatic Resources – Protection of Riparian areas	Located the spring mapped at the top of the Lavezzola trail.	
Watershed, Soils, & Aquatic Resources – Region 5 Best Management Practices	Follow the Trail Construction Standards described in the Tahoe NF Trail Design Standards document and BMPs listed in the Region 5 Soil and Water Conservation Handbook, chapter 10, sections 4.7.1 to 4.7.8.	

Figure 2. Shallow Stream Ford Schematic



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5 ENVIRONMENTAL EFFECTS – PROPOSED ACTION

BOUNDING OF EFFECTS ANALYSIS

For the soil resource assessment, the analysis area is bounded by the proposed trail alignment where the potential ground disturbing activities are proposed. The effects are bounded in time with the existing condition assessing past and present and the proposed action alternatives and the soil condition following implementation are the foreseeable future actions on these activity areas.

5.1 DIRECT AND INDIRECT SOIL EFFECTS – PROPOSED ACTION

New trail construction directly results in the removal of the organic forest litter and duff above the soil as well as the top several inches of soil. This bare soil within the trail is more susceptible to erosion. Mountain bike and dirt bike use then results in physical changes to soil properties through compaction and tread wear. Soil compaction can occur due to pressure exerted by mountain bikes and dirt bikes as wheels roll over the soil surface. As a soil becomes more compacted, the shearing of soil surfaces by mountain bikes and dirt bikes breaks up (“pulverizes”) soil particles. Tread wear occurs primarily through the skidding of tires when mountain bikes brake going downhill, or dirt bikes accelerate going uphill on steeper slopes.

Compaction and tread wear are soil physical changes that increase the susceptibility of trail erosion. Compacted soils result in decreased water infiltration rates, which in turn reduce soil moisture levels necessary to support vegetation. Compaction can also make it more difficult or impossible for native plants to establish themselves, affecting the ability of an area to recover after vegetation has been impacted. By decreasing water infiltration rates and leaving areas denuded of vegetation, compacted soils increase storm water runoff rates which can, in turn, lead to increased storm water flow and soil erosion downstream.

Reduced infiltration leads to increased overland water flow volume during intense rainstorms. Added surface water flow during and after a storm more easily overpowers the forces of cohesion and friction holding surface soil particles together. More soil particles downslope of compacted soils are eroded and transported overland as a result. The sediment load increases in the water flow cumulatively downslope and downstream, with potential adverse impacts to water quality. Overland water flow moves to streams as compacted areas upslope shed a greater amount of runoff water than they would if left undisturbed. More water volume also accelerates gully erosion in rills and creeks at “knick” points in the landscape where the slope suddenly increases. The added sediment being transported may cause water quality to decline.

Residence time is the average time that rainwater remains at the site where it falls. By infiltrating into a soil and becoming part of the groundwater, water resides on site longer. With compaction, less water infiltrates and more water flows offsite, thus shortening the average amount of time that water remains near where it strikes the ground. A longer residence time for water benefits soil organisms and vegetation at a site. With a shorter residence time for water, the soil has less water available for seed germination and plant growth. Because soil compaction reduces the amount of water that the soil can retain, the fertility of the soil is reduced.

High rates of tread wear and accelerated erosion have occurred on approximately 2 acres of trail sections described in the soil existing conditions section. These trail sections are proposed for decommissioning which would benefit the soil resource by decreasing erosion and promoting favorable conditions for the return of vegetation. Soil compaction would be expected to decrease on these decommissioned areas as roots of new vegetation decompact the soil. These same benefits would occur on the approximately 3 miles of unauthorized routes proposed for decommissioning.

Newly constructed reroute trail sections would have a low potential for soil erosion because design standards would be followed to limit trail slopes and the management requirement would be followed to design trail using the half hillslope rule. When the management requirement is followed to build trail using the half hillslope rule is, trail slope is less than half of the hill slope gradient and storm water drains from the trail rather than being diverted down the trail. The one mile Butcher Ranch reroute was constructed using the half hill slope rule in 2015 and was constructed using the same BMPs and design standards as proposed for this project. Soil monitoring was conducted this year over the one mile of Butcher Ranch reroute trail, and excessive erosion and tread wear were minimal with 99 percent of the trail in good condition. Mountain bike use is high on this trail and with a green condition after three years of use, it's expected the condition will remain stable over the long term and minimal maintenance will be required. Long term sustainability is also expected for newly constructed trail sections proposed for this project because the same trail design standards and BMPs will be used.

5.2 SOIL CUMULATIVE EFFECTS

The cumulative effects assessment area for the soil resource is bounded in space with the proposed activity area, where soil disturbing would take place. The analysis is further bounded in time by the foreseeable future period during which effects of this project could persist as detectable effects and may be short- term or long-term in nature. Past effects are accounted for based on the existing conditions or present time, and discussed in the direct and indirect effects analysis. Reasonably foreseeable future actions are limited to the use of the trail, including tread wear and tread loss due to erosion.

Ongoing tread wear and accelerated erosion are two potential future indirect effects. These would vary by both climate, season of use, and amount of use. Wet season use can result in tread wear on sections with insufficient drainage where soils remain saturated for extended periods of time. Dry season use can result in stutterbumps, and tread loss due to mechanical dusting, especially when trail use is high. Although some loosened tread is blown away as dust, most is eroded during winter precipitation on trail steeper trail sections where tail drainage is inadequate. Both wet and dry season tread wear can result in trail widening as riders avoid the rough or muddy sections. By following the BMP to monitor trail at least every three years, these problem areas can be repaired before major impacts occur. Constructing gradually sloped trail minimizes tread wear caused by mountain bike braking and uphill dirt bike acceleration. Constructing trail that follows the half hillslope rule minimizes loss of loosened tread to erosion.

5.3 DIRECT AND INDIRECT HYDROLOGIC EFFECTS – PROPOSED ACTION

Compaction of proposed new trail tread surface would decrease soil porosity and permeability, and increase overland flow. Sedimentation increases because compacted soils, and reduced vegetation cover can lead to increased amounts and velocities of runoff; in turn, this accelerates the erosion and transport of soil. Amounts of sediment would depend on rates of accelerated erosion and whether sufficient vegetation exists downslope to filter sediment before entering the channel. Generally, duff and litter below the proposed routes are very effective for filtering sediment.

Approaches to stream crossings have a higher potential for sediment delivery because of the direct hydrologic connectivitiy. Proposed trail construction could result in minor amounts of sediment entering Rattlesnake Creek, Lavezzola Creek, and Pauley Creek. One low water perennial crossings would occur on the Downie re-routes and one on the Lavezzola re-route. Following BMPs would limit the slopes and lengths of the stream crossing approaches to decrease the potential for accelerated erosion and sediment entering the channel. The potential for erosion and sediment entering stream channels would also be reduced by following the trail design standards described in the proposed action, and management requirements.

In the existing condition section of this report, water quality impacts have been described for sections of the Downie River, Pauley Creek, and Lavezzola Trails that are proposed for decommissioning. This action would require management requirements to maintain at least 70 percent soil cover on decommissioned trail which would minimize accelerated erosion and promote the return of vegetation within the old trail. As vegetation returns, soil infiltration would improve thereby benefiting the hydrology and riparian resources.

Trail construction is unlikely to result in major impacts to riparian areas. No major impacts to riparian areas were observed on the Butcher Ranch connector trail which was constructed using the same BMPs and design standards as this project.

Beneficial uses of water from the project area watersheds include domestic, municipal, agricultural, and industrial power supply, wildlife and plant habitat, support of cold water ecosystems and aquatic habitats, and contact and non-contact recreation (CA Water Quality Control Board, 2016). The newly constructed trail is not expected to have major impacts to beneficial uses.

There are no documented springs or seeps along the proposed trail.

5.4 HYDROLOGY CUMULATIVE EFFECTS

A Cumulative Watershed Effects (CWE) analysis was conducted to assess cumulative effects for the six HUC7 subwatersheds within the activity area (Table 3). Permanent features include hydraulic mines and forest activities such as clearcuts that have resulted in soil cover being removed over large areas. This cumulative watershed effects analysis compares (a) the existing level of land disturbance across all ownerships within a watershed with (b) an estimate of the upper limit of watershed tolerance to disturbance, referred to as the Threshold of Concern (TOC). The level of land disturbance is measured using Equivalent Roaded Acres (ERAs), whereby all disturbances are equated to an acre of road. The CWE analysis then recovers these disturbances over some period of time following a specified recovery curve. Using this analysis, the calculated ERA of a watershed is compared to the TOC to provide an assessment of the potential for cumulative watershed effects. The TOC is not an exact point at which effects will occur. It is an indicator that a watershed is more susceptible to impacts. As ERA approaches or exceeds the TOC, additional measures are employed to protect and monitor watershed conditions.

The ratio of ERA to TOC is less than 1 for all project 7th field watersheds. At these levels, adverse cumulative watershed effects are unlikely.

Table 3. Cumulative Watershed Effects within project 7th field watersheds

HU14 (Drainage) Name	HU14 Code	Acres	Roads ac	Trails ac	THP ac	Perm Feats ac	FACTs 10 yrs	Total	ERA	ERA/TOC
Upper Downie River	18020125010301	7,475	32	2		66	0.3	101	1%	0.11
Lower Pauley Creek	18020125010203	5,741	45	2	1	232	2.9	283	5%	0.41
Upper Lavezolla Creek	18020125010101	7,495	49	6				55	1%	0.06
Lower Lavezolla Creek	18020125010103	5,606	34	3		242		279	5%	0.42
Upper Pauley Creek	18020125010201	5,098	56	7		243		306	6%	0.50
Middle Pauley Creek	18020125010202	5,420	54	5		274	0.1	333	6%	0.51

6 ENVIRONMENTAL EFFECTS – NO ACTION ALTERNATIVE

Under the No Action Alternative, the Yuba Trails Enhancement would not be constructed. There would be no direct impacts to soil, water quality, or riparian condition. Trail reroute of existing steep sections would not occur and accelerated erosion and tread wear would continue. Existing impacts to water quality from these sections would also occur. Future trail maintenance would continue, yet its unlikely trail condition would be improved on these overly steep sections.

7 References

California Regional Water Quality Control Board, Central Valley Region, 2016. **Water Quality Control Plan, Sacramento Basin, revised April, 2016**. Available at: http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/index.shtml

Montgomery, D.R. and J.M. Buffington, 1997. Channel-reach morphology in mountain drainage basins: Geological Society of America Bulletin, v. 109, no. 5, p. 596-611.

USDAFS, 1990**. Tahoe National Forest Land and Resource Management Plan.**

Appendix 1 – Summary of Applicable BMPs

BMP 4.7 - Best Management Practices for Off-Highway Vehicle Facilities and Use (BMPs 4.7.1 to 4.7.9)

Over the past few decades, the availability and capability of off-highway vehicles (OHV) have increased tremendously, as has the intensity of OHV use on NFS lands. While these vehicles have provided new recreational opportunities and access to otherwise remote locations, this increase in OHV use has the potential to impact water resources.

1. OHV use near water bodies, particularly at stream crossings, has the potential to:

   a. Deliver sediment, particularly during storm events

   b. Cause vertical and lateral erosion of stream channels

   c. Destroy or weaken riparian vegetation, compromising stream-bank stability and increasing water temperature

   d. Pollute waters with petroleum and chemical products and other organic and inorganic waste, including human pathogens

2. Careful and wise management of OHV use can mitigate these impacts. The purpose of this set of BMPs is to control nonpoint source pollution that may occur because of OHV recreation activities on NFS lands. The types of OHV activities that could directly or indirectly affect water quality include:

   a. Trail planning

   b. Trail location and design

   c. Trail construction and reconstruction

   d. Operations and maintenance

   e. Monitoring

   f. Restoration of OHV-damaged areas.

3. This set of BMPs applies to OHV trails, with the exception of BMP 4.9, which is specific to concentrated-use area management. For the purpose of this set of BMPs, the term “OHV Trail” means trails managed for OHV use. The three types of OHV trails are:

a. Single-track trails - 12 to 24 inches in width, used by off-highway motorcycles

b. Double-track trails - 50 inches or less in width, used by off-road motorcycles and all-terrain vehicles

c. Four-wheel drive or high-clearance trails - 50 inches or greater in width, used by off-road motorcycles and all-terrain vehicles, side-by side utility terrain vehicles, and high-clearance four-wheel drive vehicles.

Best management practices for roads utilized by OHVs, such as high-clearance vehicle roads (Maintenance Level - 2), are covered under the set of roads BMPs. It is important to recognize

the distinction between OHV trails and OHV routes on roads, because their design, construction, management, and potential impacts to water quality are quite different. This distinction is with the full acknowledgement that a large percentage of OHV use occurs on Maintenance Level - 2 roads, and that many OHV trails have evolved from old roads or firebreaks.

Sediment is by far the primary pollutant associated with OHV activity, although human waste and petroleum products from concentrated use areas can be pollutants locally. Discharges of sediment into California's waters that are associated with OHV activity are caused by accelerated soil erosion.

Trails are linear features that concentrate runoff. When runoff concentrated on a trail flows directly to a watercourse or water body, the trail becomes part of the drainage network, and creates hydrologic connectivity. OHV trails located near watercourses and water bodies have a high potential for hydrologic connectivity. Consequently, watercourse crossings and OHV trails located near them have the greatest risk for sediment delivery from off-highway vehicle activity.

Trails can also alter natural drainage patterns by intercepting, diverting, blocking, and concentrating surface and subsurface flows. Proper off-highway vehicle management, including trail location, design, construction, and maintenance, can reduce the impact to natural hydrologic functions and water resources.

Drainage treatments such as out-sloping, inside ditches, and crowned prisms are effective on roads, but are not typically effective on OHV trails. OHV trails typically occur in native soil material that easily erodes. This is in contrast to roads, which are constructed from deeper sub-soil or regolith. Roads are also typically wider, have larger cut and fill slope, a more compacted prism, and generally have gradients that are less steep than OHV trails. Watercourse crossings on OHV trails are not designed and constructed the same way watercourse crossings for roads are. Because of these differences, the potential for sediment delivery from OHV trails is not the same as for OHV routes on roads, and BMPs developed for OHV trails differ from those developed for roads.

Additional site-specific practices may be needed for water bodies listed pursuant to Clean Water Act section 303(d) as being impaired by sediment, siltation, or turbidity; and for key watersheds in the areas covered by the Northwest Forest Plan and the Sierra Nevada Framework.

Authorities

The Travel Management Rule (36 CFR, Parts 212, 251, and 261) adopted in 2005, and the Forest Service Manual and Forest Service Handbook provide the framework for managing OHV use on

NFS lands. These resources contain the mandate for the Forest Service to designate routes for motor vehicle use by vehicle type, and if applicable by time of year, and to identify the route designations and seasonal restrictions on a motor vehicle use map.
Both the Northwest Forest Plan and the Sierra Nevada Framework incorporate Aquatic Conservation Strategies that encourage identification of key watersheds on NFS lands where protection of aquatic and riparian resources is a priority.

The Forest Service receives grant funding from the California State Parks Off-Highway Motor Vehicle Recreation Division grant program to help manage, operate, maintain, and develop OHV use on NFS lands. Where applicable, the Forest Service will use these BMPs to achieve the California State Parks, 2008 Soil Conservation Standard associated with receiving monies from the California OHV Trust fund. The soil standard specifically requires management of OHV activities to avoid impacts to both on-site and off-site resources, including water quality.

This Water Quality Management Handbook provides specific practices to protect and restore water quality while providing opportunities for OHV recreation.

Objective: To use the travel management planning processes, including travel analysis, to develop measures to avoid, minimize, and mitigate adverse impacts to water, aquatic, and riparian resources during OHV management activities, and to identify restoration for OHV-damaged areas and trails not designated for use.

Explanation: The amount, type, and location of OHV trails are determined through various planning processes. OHV trail planning includes travel analysis as well as trail management at the project level. Planning occurs at scales that can range from forestwide assessments and plans, to watershed-scale analyses, to project-level trail activities. During planning, potential effects on water, and on aquatic and riparian resources are identified, and protection and mitigation measures are proposed.

Trail management objectives are developed to define the type of recreation experience each trail is designed to provide, and to provide direction on management of the trail. In addition to guiding trail management at the site-specific scale, TMOs also document Forest-wide trail maintenance needs and identify the potential for environmental effects and conflicts with other resources.

The risk from OHV trail management activities can be reduced by using the appropriate techniques from the following list, adapted as needed to local site conditions.

Implementation:

1. Conduct travel analysis to determine the appropriate trail system for the recreational objective.

   Plan trails to:

   a. Minimize the number of stream crossings

b. Avoid locations near wetlands (for example, seeps, springs, marshes, and wet meadows)

c. Favor existing trails over new construction when less damage to water quality will occur

2. To the degree feasible, locate new construction on natural benches, flatter slopes, and stable soils. Avoid locating new trails on:

a. Areas prone to mass wasting

b. Slopes steeper than 55 percent

c. Slopes steeper than 45 percent where the erosion potential is high or extreme

Limit steep pitches to less than 200 feet where possible.

3. Identify trail segments causing adverse impacts to water resources and prioritize mitigation measures such as:

a. Relocate existing trails or trail segments that are in high-risk locations, including SMZs, riparian areas, and meadows, to restore surface and subsurface hydrologic function

b. Reconstruct trails to improve, modify, or restore effective drainage

c. Upgrade stream crossings

d. Develop or update a trail management objective for each trail:

e. Define the recreation experience and level of difficulty the trail is designed to provide.

f. Identify current and future needs and uses of each authorized trail in the trail management objective.

g. Determine whether existing trail design standards are adequate to support the defined recreational experience, and whether impacts to water, aquatic, and riparian resources are likely to result from not following trail management objectives.

h. Identify trails that are managed differently and/or are serving purposes other than those identified in trail management objectives. Modify the objective to match the intended use and management of the trail.

i. Operate the trail as intended by the trail management objectives until they are revised and/or the trail is reconstructed to accommodate different uses.

12.41 Exhibit 09
BMP 4.7.2 - Location and design

Objective: To reduce the risk that sediment originating from designated OHV trails and OHV areas will enter watercourses and water bodies by locating OHV trails to minimize hydrologic connectivity, and by incorporating drainage structures into trail design to disperse concentrated runoff.

Explanation: Proper on-site location and design of OHV trails are essential, particularly at stream crossings (see BMP 4.3).

The amount of sediment delivered to a water body from an OHV trail is affected by runoff concentration and hydrologic connectivity. Properly located and designed drainage structures disperse concentrated runoff. Typically, runoff as overland flow will not penetrate a buffer strip, but runoff concentrated in rills or gullies will.

1. The potential to deliver sediment originating from OHV trails and OHV areas to watercourses and water bodies is a function of the:

    a. number, location, and design of watercourse crossings

    b. volume and energy of concentrated flow leaving the trail or area

    c. ability of the intervening terrain to absorb or disperse concentrated flow, including slope gradient and surface cover

    d. distance between the trail and the receiving water body

    e. inherent erodibility of the soil

The first four of these five factors determine the hydrologic connectivity between the trail and the watercourse or water body. Watercourses are so important in managing the effects of OHV use on water quality that they have a BMP of their own (BMP 4.3).

Techniques included in this BMP are intended to improve drainage and reduce or eliminate the hydrologic connectivity of trails and watercourses. The risk from OHV use can be managed by using the appropriate techniques from the following list, adapted as needed to local site conditions.

2. Implementation Techniques:

12.41 Exhibit 09 -- Continued
BMP 4.7.2 - Location and design

Trail Location

a. Locate trails and drainage structures to minimize hydrologic connectivity.

b. Limit the number of watercourse crossings to those needed to meet the recreational objective.

c. Maximize the filter distance between the trail and the water body.

d. Locate drainage structures where dispersion or absorption of runoff is effective.

e. Avoid sensitive areas such as riparian areas, wetlands, meadows, bogs, fens, inner gorges, and unstable landforms.

f. Avoid the capture, diversion, and/or concentration of runoff from slopes adjacent to OHV trails.

g. Locate steep trail segments on well-armored locations than can sustain traffic without accelerated erosion.

3. Trail Design to Reduce Potential for Discharge of Pollutants to Surface Waters

a. Design and space trail drainage structures to remove storm runoff from the trail surface before it concentrates enough to initiate rilling.

b. Design trails to dissipate intercepted water by rolling the grade.

c. Where trails cannot be effectively drained by rolling the grade or using reverse grades, provide trail drainage using OHV rolling dips as specified in Rolling Dips for Drainage of OHV Trails, USDA-Forest Service, Pacific SW Region, January, 2006.

d. Wherever possible, incorporate sediment basins at OHV rolling dip outlets instead of lead off ditches.

e. Where sediment basins cannot be installed, provide energy dissipaters at OHV rolling dip outlets.

f. Design trails to be no wider than necessary to provide the recreation experience defined in the trail management objective.

12.41 Exhibit 09 -- Continued
BMP 4.7.2 - Location and design

g. Incorporate design elements that discourage off-route use (for example, taking shortcuts, cutting new lines).

h. Extend drainage outlets beyond the toe of fill or side-cast.

i. Install aggregate, paver blocks, or other surfacing treatment on tread segments that are steep, erodible, or heavily traveled.

12.41 Exhibit 10
BMP 4.7.3 - Watercourse Crossings

Objective: To prevent or minimize the discharge of sediment into water bodies when locating, designing, constructing, reconstructing, and maintaining watercourse crossings.

Explanation: The importance of watercourse crossings in managing the effects of OHV use on water quality cannot be overemphasized. Of the pollutants generated by OHV use, sediment has by far the greatest volume. The greatest potential for sediment delivery is at and near watercourse crossings where the potential for hydrologic connectivity is high. The approaches to watercourse crossings are typically constructed in native soils that can erode and deliver sediment to channels.

Typical OHV watercourse crossings include low-water crossings, fords, bridges, arched pipes, culverts, and permeable fills. Crossing materials and construction vary based on the type of trail and kind of use. To minimize impacts to water quality, design new crossings to provide for the unimpeded flow of water, bed-load, large woody debris, and aquatic organisms. Watercourse crossings must be constructed with minimal disturbance to the streambed and to surface and shallow groundwater resources.

The approaches to watercourse crossings and fill-slopes are especially important. All sediment resulting from erosion on these surfaces is delivered directly into the watercourse.

Construction, reconstruction, and maintenance of watercourse crossings often require equipment to be in and near streams, lakes, and other aquatic habitats. Such disturbance can increase the potential for accelerated erosion and sedimentation by destabilizing stream banks or shorelines, removing vegetation and ground cover, and by exposing and compacting the soil. Permits, including Section 404 permits administered by the U.S. Army Corps of Engineers and Section 401 Water Quality Certifications administered by Regional Water Quality Control Boards may be required for in-stream work associated with stream-crossing construction and maintenance projects.

The risk of sediment delivery at watercourse crossings can be managed by using the appropriate techniques from the following list, adapted as needed to local site conditions. Location, construction, and maintenance of watercourse crossings, and assessment of watercourse crossing condition, require consultation with qualified personnel.

1. Implementation:

   Crossing Location--

12.41 Exhibit 10
BMP 4.7.3 - Watercourse Crossings

a. Locate new OHV trails to limit the number of watercourse crossings to those necessary to meet planned activity objectives (see also BMP 4.1).

b. Avoid long, steep OHV trail segments on approaches to watercourse crossings.

c. Orient stream crossings perpendicular to the channel in straight and resilient stream reaches.

2. Trail Approaches to Watercourse Crossings—

a. Where possible, make crossing approaches short and level, or reverse the grade if possible.

b. Install cross drainage (cut-off waterbreaks) at crossings to prevent water and sediment from being channeled directly into watercourses.

c. Locate cut-off waterbreaks as close to the crossing as possible without being hydrologically connected to the watercourse.

d. Armor steep crossing approaches with stable aggregate or trail-hardening materials.

e. Where possible (for example, at bridges or arch culverts), reverse the grade of the crossing approaches so runoff drains away from the watercourse.

3. Design of Watercourse Crossings--

a. Design crossing approaches and nearby drainage structures to minimize hydrologic connectivity.

b. Design watercourse crossings to avoid diversion of flow down the trail should the crossing fail.

c. Rocked diversion potential prevention dips and rock armoring of downstream crossing fill will be used to minimize potential for failure of trail-stream crossings.

d. Design watercourse crossings for a 100-year storm event, to allow for unobstructed flow including bed-load and organic debris, and to provide for passage of desired aquatic and terrestrial organisms.

e. Harden crossing approaches as needed to minimize soil displacement by traffic.

12.41 Exhibit 10--Continued
BMP 4.7.3 - Watercourse Crossings

f. Place stable materials below the outlets of cut-off waterbreaks to dissipate energy.

g. Set crossing bottoms at natural levels of channel beds.

h. Harden fords with gravel or cobble of sufficient size and depth to prevent movement by traffic.

i. Construct watercourse crossings to sustain bankfull dimensions of width, depth and slope, and to maintain streambed and bank resiliency.

j. Instead of pipe culverts, use bridges, bottomless arches, or buried pipe-arches for watercourses with identifiable floodplains and elevated trail prisms.

k. Cross wet areas with naturally high water tables with permeable fills, perched culverts, and/or culvert arrays to maintain hydrologic function.

l. Use Forest Service design specifications for bridges.

4. Construction of Watercourse Crossings--

a. Conduct construction operations during the least critical periods for water and aquatic resources (usually during low-water conditions and non-spawning/breeding seasons).

b. Disturb as little area as possible when crossing watercourses.

c. Minimize excavation of stream banks and riparian areas during construction.

d. Keep excavated materials out of channels, floodplains, wetlands, and lakes.

e. Stabilize adjacent areas disturbed during construction.

12.41 Exhibit 11
BMP 4.7.4 - Construction, reconstruction

Objective: To prevent or minimize the discharge of sediment into water bodies during construction, reconstruction, and realignment of OHV trails.

Explanation: Vegetation and ground cover is removed during trail construction and reconstruction, exposing the surface and subsurface soil to erosion. Temporary and long-term erosion control measures are necessary to minimize erosion and sediment delivery. The risk of erosion and sediment delivery from trail construction and reconstruction activities can be managed by using the appropriate techniques from the following list, adapted as needed to local site conditions.

Implementation:

Develop and implement an erosion and sediment control plan that describes:

1. Amount of vegetative clearing and amount of soil material to be moved
2. Proposed erosion control measures to prevent soil detachment and mobilization
3. Proposed sediment control measures to capture mobilized sediment
4. Proposed sequence of implementation for erosion and sediment control treatments

Maintain erosion and sediment control measures to function effectively to prevent discharges of pollutants to surface waters throughout the project area during trail construction and reconstruction.

Keep erosion and sediment control measures sufficiently effective during ground disturbance to allow rapid closure and site stabilization if weather conditions deteriorate. For each project, specify a rainfall probability threshold (generally 30 to 50 percent, based on National Weather Service local forecasts) at which wet-weather sediment control measures will be installed.

Complete all necessary stabilization measures prior to predicted precipitation that could result in surface runoff.

Complete erosion and sediment control treatments before leaving project areas for the winter or rainy season.

Do not operate equipment when ground conditions could result in excessive rutting, or runoff, that could deliver sediment directly to watercourses or water bodies.

12.41 Exhibit 11--Continued
BMP 4.7.4 - Construction, reconstruction

When constructing trails near SMZs, do not permit side casting of soil into the SMZ.

Windrow slash and organic litter at the base of fill slopes to trap sediment.
Construct OHV rolling dips when soil moisture is sufficient to allow adequate compaction of OHV rolling dip drainage structures.

Close newly constructed trails for one season to allow consolidation of soils in treads and drainage structures, so treads and structures can better withstand OHV traffic.

12.41 Exhibit 12
BMP 4.7.5 - Monitoring

Objective: To reduce the risk of sediment delivery to water, aquatic, and riparian resources by identifying watercourse crossings and OHV trail segments in need of maintenance, by setting priorities for maintenance, and by identifying OHV areas and trails that require closure and restoration.

Explanation: The Forest Service will schedule systematic monitoring of OHV trails, activities and effects to detect existing and probable impacts to water quality, aquatic and riparian resources. If adverse water-quality effects are occurring, or there is a potential for substantial adverse impacts to water quality, the Forest Service will take immediate corrective action. Corrective actions may include, but are not limited to:

1. Temporary or permanent erosion and sediment control treatments
2. Barriers and signing to redistribute use
3. Temporary closure of trails or areas until completion of corrective action
4. Partial or total closure and restoration of trails or areas
5. Reduction in the amount, type, or season of OHV use

Implementation:

Monitoring specific to OHV trails is included here and in chapter ### of this Water Quality Management Handbook.

Conduct G-Y-R Trail Condition Monitoring as described in Revised OHV Trail Monitoring Form (GYR Form) and Training Guide, USDA-Forest Service, Pacific SW Region, July 30, 2004, to identify trails and watercourse crossings in need of maintenance and to prioritize maintenance activities.

Evaluate all watercourse crossings rated “red” during the G-Y-R Trail Condition Monitoring in consultation with a qualified watershed specialist.

Schedule G-Y-R Trail Condition Monitoring so high-risk and high-maintenance trails are monitored annually; schedule the monitoring of stable trails less frequently, but not less than every 3 years.

12.41 Exhibit 12--Continued
BMP 4.7.5 - Monitoring

Monitor a 2.percent sample of trails each year using the Trail Assessment and Condition Survey (TRACS) protocol.

Monitor the effectiveness of the OHV BMPs using the established the Pacific Southwest Region BMP effectiveness monitoring program.

During routine inspections of OHV trails and while conducting photo point monitoring, use a standardized form to document and report newly created unauthorized OHV use, and trail segments with potential water-quality impacts.

Temporarily close trails that pose immediate significant threats to water quality. As a minimum, install temporary erosion and sediment control treatments prior to the winter season.

Permanently close and restore trails that cannot sustain OHV use without causing adverse effects to the beneficial uses of water per Water Quality Management Handbook objective 2 (page 8).

BMP 4.7.6 - Maintenance and Operations

Objective: To prevent or minimize discharges of sediment into watercourses and water bodies by maintaining OHV trails and associated drainage structures.

Explanation: OHV trails are linear features constructed in native soil that concentrate runoff. Except for occasional hardened segments, trails are not typically surfaced with aggregate. In addition, normal OHV traffic tends to create an outside berm along the tread. Due to the presence of this berm, and to gradients typically steeper than roads, runoff from trails cannot be readily drained by crowning or out-sloping as it can for roads. Drainage and erosion control facilities cease to function if they are worn down by continued traffic. These factors make periodic maintenance and field inspection critically important in minimizing the impacts of OHV use on water quality.

Trail drainage systems may further increase hydrologic connectivity if they deteriorate because of use, weather, or inadequate maintenance. Trail drainage facilities may become inadequate after wildfires or extreme precipitation events due to increased surface runoff, loss of vegetative cover, and stream bulking. New springs and seeps occasionally saturate trails after the occurrence of a wildfire or following unusually wet periods. Timely maintenance can correct these conditions.

Drainage structures constructed with mechanized equipment last longer than hand-constructed drainage. However, trail maintenance with mechanized equipment such as SWECO-type trail tractors and mini-excavators can disturb soil, making it susceptible to erosion. Less aggressive maintenance is often necessary to minimize disturbance of stable sites.

The construction of OHV rolling dips is from native soil material. For these structures to hold up under traffic they need to be well compacted. This requires moist soils and the scheduling of maintenance to exploit the narrow window of time when soil moisture is optimal for compaction.

Obstructions to traffic such as fallen logs and potholes can lead to trail braiding, puddles, and off-trail traffic. Prior to opening trails for use—or periodically for trails open year-round—clearing trails of obstructions can reduce the need for repair and restoration. Volunteers do much of this work.

Trail management objectives define the designed use, type of recreation experience, and the level of difficulty that a trail is designed to provide. It is important to maintain trails to the defined maintenance rotation, designed use and level of difficulty. The deterioration of trails to a more challenging difficulty level due to a lack of maintenance can affect water resources. More challenging trails often produce more sediment.

12.41 Exhibit 13--Continued
BMP 4.7.6 - Maintenance and Operations

The effects of trail maintenance activities on water quality are managed by using the appropriate techniques from the following list, adapted as needed to local site conditions.
Implementation:

1. Maintenance Planning

Develop and implement annual maintenance plans based on the results of the G-Y-R and TRACS trail condition surveys and other periodic inspections (see BMP 4.7.5).

Schedule maintenance to maximize the time period when soils are at optimal moisture levels for soil compaction.

2. Inspection

Periodically inspect, monitor, and assess trail condition to assist in setting maintenance priorities (see BMP 4.7.5).

Identify the need for additional drainage structures, spot rocking, or trail hardening to protect and maintain water, aquatic, and riparian resources.

3. After major storm events, to the extent staffing allows, inspect potential problem trails, drainage structures, and runoff patterns and, as needed:

   a. Clean out, repair, or reconstruct drainage structures that are not functioning

   b. Clear the tread of obstructions to traffic that could lead to trail braiding or off-site impacts

4. Maintenance Activities

As per Regional Forester's direction dated November 8, 2002, follow the maintenance standards and guidelines in A Field Evaluation of the Use of Small Trail Tractors to Maintain and Construct OHV Trails on National Forests in California, USDA-Forest Service Pacific SW Region, August 22, 2001. Specifically, these standards and guidelines are:

   a. Use certified operators, or persons under their direct supervision, to operate trail tractors and mini-excavators.

   b. Construct new trails using R-5 design standards.

12.41 Exhibit 13--Continued
BMP 4.7.6 - Maintenance and Operations

c. Close newly constructed trails to all use for one season.

d. Construct OHV rolling dips using design standards

e. Before moving equipment in, examine trails to determine the need for maintenance with mechanical equipment.

f. Lift the blade and walk equipment across sections of trail that need no maintenance.

g. Examine drainage structures, and the tread between them, for evidence of tread loss before starting maintenance.

h. At failed drainage structures, determine the cause of failure before starting repairs.

i. Recycle soil collected in rolling dip outlets into rolling dip structures or back into the trail tread.

j. Do not blade outside berms off the trail as side-cast; work berms back into the trail tread.

k. Repair rills and gullies in treads with soil reclaimed from rolling dip outlets or from outside berms, not with soil bladed from the trail tread.

l. Blade soil sloughed from cutbanks, or from sideslopes above trails, only as needed to maintain a safe trail; do not undercut or blade into cutbanks.

m. Repair “stutterbumps” by ripping, blading, and compacting the trail tread when soil is moist (except for non-cohesive soils).

n. Move the smallest amount of soil necessary to meet the maintenance objective.

o. Defer maintenance on drainage structures, or do hand maintenance, where soil is too dry or too wet for compaction.

p. Maintain trail surfaces to dissipate intercepted water in a uniform manner along the trail by the use of OHV rolling dips.

q. Groom trails as needed with a rock rake to keep drainage outlets open.

12.41 Exhibit 13--Continued
BMP 4.7.6 - Maintenance and Operations

5. Operations

Restrict OHV travel to designated trails or designated motor vehicle use areas.Prior to opening trails for use, clear obstructions to traffic to avoid braiding.

Close trails or restrict OHV use when the potential for sediment delivery is high or during periods when such use would likely damage the tread or drainage features (also see BMP 4.7.7).

12.41 Exhibit 14
BMP 4.7.7 - Wet-weather operations

Objective: To prevent or minimize the discharge of sediment into water bodies by closing OHV trails to traffic when soil strength is low and trail treads and drainage structures are susceptible to damage.

Explanation: Soil strength decreases as moisture increases. When soil strength is low, OHV traffic can lead to tread failure and damage to drainage structures, including OHV rolling dips. Damage to trail drainage structures increases the risk of sediment delivery to watercourses and water bodies. Soil is easily displaced when soil strength is low. Under these conditions OHV traffic near watercourses and on crossing approaches can result in direct delivery of sediment.
The susceptibility of OHV trails to damage when soil strength is low varies with soil type, amount of traffic, and type of vehicle. Each OHV area has a unique combination of soil types and precipitation patterns that determine the appropriate implementation techniques to minimize impacts to water resources during wet weather.

Implementation: To manage the potential for sediment delivery from OHV use when soils are wet, the Forest Service will use its authority under 36 CFR Section 261 to close designated OHV trails and areas to vehicular travel. This must be done seasonally by a given date, or be based on local conditions such as precipitation, or measurements of soil trafficability. Use the following techniques, as appropriate for local conditions, to manage OHV trail systems under wet weather conditions:

1. Develop a wet-weather management plan.

2. Close trails seasonally for the months when soil moisture is typically high and sedimentation is likely to occur; or

3. Close trails for a core period when soil moisture is expected to be high, and extend the closure period as needed, based on precipitation or soil trafficability, or

4. Determine the levels of soil strength and moisture at which OHV trail damage begins to occur for typical traffic, and close trails when measurements of soil strength predict a high risk of damage to drainage structures and trail treads.

Identify benchmark locations where measurements of precipitation or soil trafficability will be taken to determine when trails will be closed.

Identify trails, or loops of trails, with similar conditions that can be selectively closed.

Identify and re-route or reconstruct trail segments that cause entire trail systems to be closed because they retain moisture longer than is typical for the trail system.

12.41 Exhibit 15
BMP 4.7.8 - Restoration of off-highway vehicle-damaged areas

Objective: To prevent or minimize the discharge of sediment into watercourses and water bodies by permanently restoring OHV-damaged areas, watercourse crossings, and OHV trails no longer designated for use.

Explanation: Loss of surface duff, litter, and vegetation leaves soils exposed and easily eroded. Ruts and tracks created by OHV traffic are unnatural channels that concentrate surface runoff and increase its erosive power. OHV traffic can also compact soils, causing increased surface runoff.

OHV traffic in wet meadows and marshes damages the root network that stabilizes sensitive soils. This can cause stream incision, which lowers the water table and results in a loss of meadow and riparian vegetation.

OHV-damaged areas, and OHV trails no longer available for use, are identified during the route designation process at the forest and watershed level and during trail condition surveys and monitoring (see BMP 4.5). Identify additional trail segments for restoration when rerouting trails.

Restoration of OHV-damaged areas and closed trails includes activities that stabilize and restore the landscape to a more natural state. Treatments can range from simply scattering slash or raking in duff and litter, to watercourse or meadow restoration, to using heavy equipment to break up compaction, fill in incised trails, reshape the area to its natural contour, and install drainage structures. Planting native vegetation helps stabilize slopes by absorbing the impacts of rainfall and overland flow.

Effective closure from OHV traffic is essential to allow restored sites to recover.
Accomplish restoration of OHV-damaged landscapes by using the appropriate techniques from the following list, adapted as needed to local site conditions.

1. Implementation:

   Restoration of Trails and OHV-damaged Areas

   When planning the restoration of OHV-damaged trails and areas, consider the following steps taken from Restoration of OHV-damaged Areas - A Ten-Step Checklist, USDA-Forest Service, Pacific SW Region, May 31, 2006:

12.41 Exhibit 15--Continued
BMP 4.7.8 - Restoration of off-highway vehicle-damaged areas

a. Identify the source of the problem

b. Effectively close the area to OHV traffic

c. Reshape the land surface to its original contour

d. Disperse concentrated runoff

e. Prepare the seedbed

f. Planting or seeding

g. Stabilize the surface

h. Signing

i. Enforcement and monitoring

j. Remove signs and barriers

Few sites will require all ten steps. A more complete description of each step is included in the report. Additional information on restoring OHV-damaged areas can be found in Restoration of Off-Highway Degraded Landscapes (in press) USDA-Forest Service, San Dimas Technology and Development Center 2010.

2. Restoration of Watercourse Crossings

Restoration of watercourse crossings should be done under the direction of—or after consulting—a qualified watershed specialist. A permit may be required if in-channel work is necessary.

When restoring OHV watercourse crossings, follow these general guidelines as appropriate:

a. Remove all trail-hardening materials and fill, and restore the channel bottom to its natural gradient and width.

b. If necessary, replace hardening material in the channel with cobble similar in size to the native bed-load.

12.41 Exhibit 15--Continued
BMP 4.7.8 - Restoration of off-highway vehicle-damaged areas

c. Restore crossing approaches to ensure that surface runoff does not reach the watercourse.

d. If necessary to divert runoff from crossing approaches, install cutoff waterbreaks as close to the crossing as feasible without creating hydrologic connectivity.

e. To the extent possible, reshape the streambanks to their former natural contour.

f. Stabilize and revegetate the streambanks.